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Nanoscale Analysis of Interwall Interaction in a Multiwalled Carbon Nanotube by Tip-Enhanced Raman Spectroscopy SONGPOL CHAUNCHAIYAKUL, TAKESHI YANO, KAMONCHANOK KHOKLANG, PAWEL KRUKOWSKI, MEGUMI AKAI-KASAYA, AKIRA SAITO, YUJI KUWAHARA, Osaka University — Raman spectroscopy is a useful tool for the study of carbon materials, but its spatial resolution is limited by the optical diffraction limit. Recently, we constructed a scanning tunneling microscope-based tip-enhanced Raman spectroscopy (STM-TERS) system in ultrahigh vacuum, which overcomes the optical diffraction limit, and enables the investigation of single-molecular Raman spectra simultaneously with topographic imaging. We have investigated position-sensitive Raman spectra along the tube axis of an isolated multiwalled carbon nanotube, which is a result of the different number of nanotube walls at each location. We found that the intensity ratio between the 2D to the G band increases with the number of walls. This indicates that the quantum interference between Raman scattering pathways affects each Raman mode differently. The interaction between nanotube walls induces splitting of the π and π^* bands which increases the number of the 2D band scattering pathways owing to double resonance, eventually increasing the probability of scattering for the 2D band relative to the G band. These results provide a deeper understanding of the single-molecule interaction of carbon materials in the nanoscale.

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